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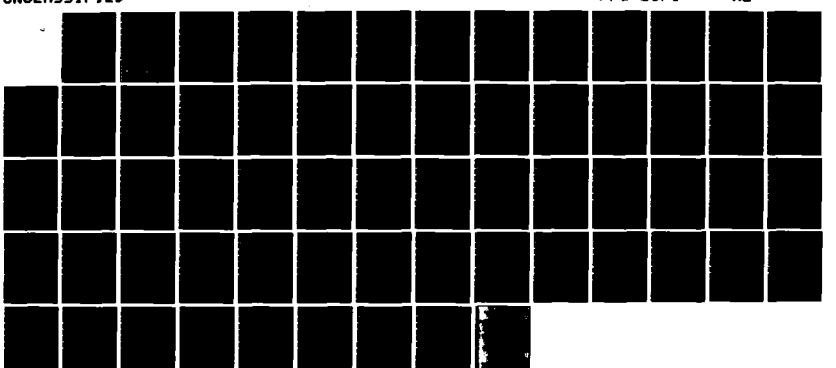

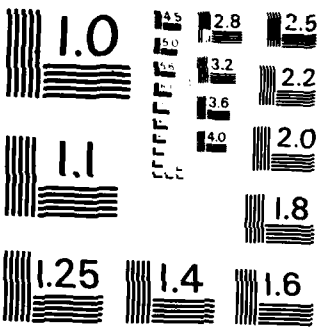

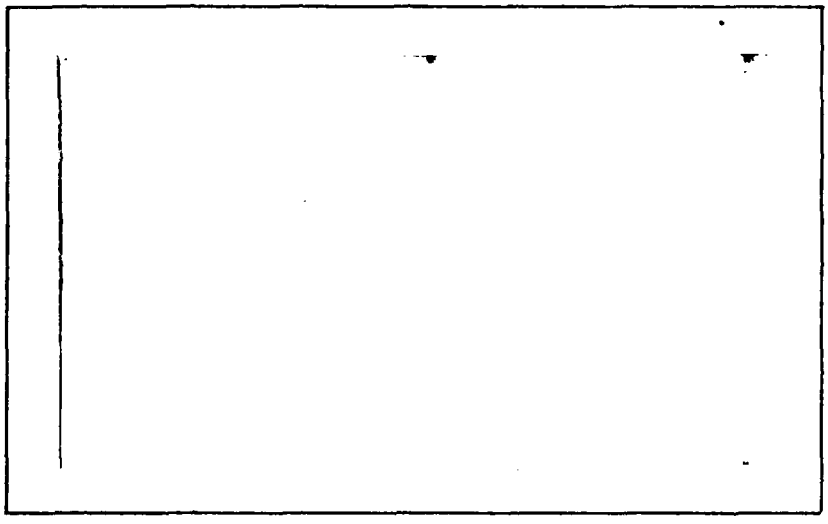

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Applied Research in Statistics - Mathematics - Operations Research

AN EVALUATION OF THE WSSC COST ALLOCATION ALGORITHMS V: DEPOT LEVEL CATEGORIES

by

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This report by Desmatics, Inc. is the fifth in a series of volumes which review procedures used by the Weapon System Support Cost (WSSC) subsystem of the Air Force Visibility and Management of Operating and Support Costs (VAMOSC) system to allocate operating and support costs to Air Force weapon systems. This volume presents the results of an examination of the algorithms and data WSSC uses to allocate costs incurred in operation of the Air Force Logistics

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Command (AFLC) depots. Four cost categories are included in this report: depot maintenance, general depot support, depot installation support and sustaining investment.

Desmatics makes several specific recommendations for changes in WSSC processing, and raises several questions for review by Office of VAMOSC personnel pursuant to possible development of additional changes. Desmatics' conclusions and recommendations are listed in this report, together with accompanying comments from the Office of VAMOSC.

EXECUTIVE SUMMARY

This report by Desmatics, Inc. is the fifth in a series of volumes which review procedures used by the Weapon System Support Cost (WSSC) subsystem of the Air Force Visibility and Management of Operating and Support Costs (VAMOSC) system to allocate operating and support costs to Air Force weapon systems. This volume presents the results of an examination of the algorithms and data WSSC uses to allocate costs incurred in operation of the Air Force Logistics Command (AFLC) depots.

Four cost categories are included in this report: depot maintenance, general depot support, depot installation support and sustaining investment. For each cost category the process used to produce the FY81 WSSC report is described and evaluated. However, many enhancements have been made in FY82 or are being considered for implementation in FY83. Where possible, these enhancements are described and evaluated as well. Desmatics' observations and conclusions are summarized in the following paragraphs. They are discussed in more detail in the body of this report, and are reviewed in the conclusion section (Section VIII).

Two changes are planned for depot maintenance by the Office of VAMOSC. One, which will use data on depot completions, will provide better visibility of costs at the command-base-MDS (mission-design-series) level. Another, which provides for separating modification kit installation costs will enable WSSC to report programmed depot maintenance (PDM) costs cleanly, without confounded modification expenses.

With regard to general depot support, efforts are proposed in two

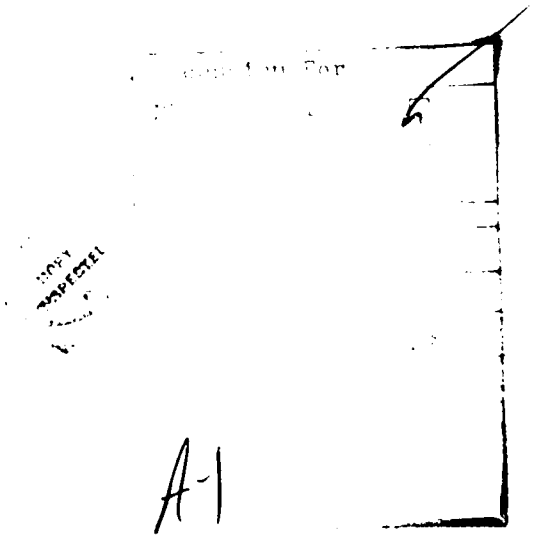
areas. The first is to identify drivers of costs separately for the three depot supply directorates. This would alter the way in which WSSC identifies the aircraft share of the directorates' costs. The second is to change the ratio that allocates worldwide costs to the command-base-MDS level. Currently flying data is used. Desmatics supports a change to the use of completions and/or NRTS (not reparable this station) actions data.

Desmatics recommends investigating a change to depot installation support processing so that a regression equation is used to identify a fixed portion of these costs that can then be excluded from allocation. Another recommendation is that a portion of installation support costs be identified as attributable to the operation of the supply directorates and that this cost be added to the costs allocated among the command-base-MDSs. Desmatics concurs with the proposal that completion and NRTS actions data be used to allocate depot support costs to the command-base-MDS level.

In general, changes contemplated for processing sustaining investment costs are such that reported costs will reflect estimated expenditures for consumption rather than investment. These changes are consistent with the objective of WSSC to construct a historical record of weapon system costs. In addition, Desmatics proposes inclusion of ground support equipment expenses. It is recommended that these costs be treated as overhead costs and be allocated among command-base-MDSs on the basis of direct maintenance labor costs.

This volume also contains a section which describes the data assessment procedures by which Desmatics identified three processing errors in

the FY81 production run and discusses the impact of these errors on the reported costs.



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I. INTRODUCTION

Desmatics, Inc. under Contract No. F33600-80-C-0554, is conducting an evaluation of the cost allocation algorithms employed in the Weapon System Support Cost (WSSC) subsystem of VAMOSC, the Air Force Visibility and Management of Operating and Support Costs system. This report is the fifth in a set of volumes which discuss the scope and findings of the Desmatics study.

The purpose of this volume is to evaluate the WSSC procedures which collect and allocate depot-related costs to Air Force aircraft weapon systems. Desmatics has examined the reasonableness of the data and procedures used in selecting, classifying and allocating depot costs to weapon systems, assessing whether they may be expected to provide equitable results.

The WSSC system collects cost data for four types of expenditures which are incurred by AFLC depots for services rendered with respect to aircraft weapon systems. These costs are reported under the headings:

1. Depot maintenance,
2. General depot support,
3. Depot installation support,

and 4. Sustaining investment.

The Statement of Work under which this Desmatics study was initiated calls for the evaluation of the WSSC system algorithms as set forth in system specifications dated June 1980. The WSSC system has evolved almost continually since that time, reflecting improvements that were made in virtually every aspect of the system logic prior to the first production

runs in April 1982. Additional modifications and enhancements were made to WSSC between the first production run in 1982 and the second run made in April 1983, and more are planned for the immediate future.

Desmatics recognizes that to restrict its evaluation to the June 1980 baseline would significantly limit the usefulness of its findings. Accordingly, Desmatics has kept pace with the evolution of the WSSC system, and has attempted to reflect the significant system changes in its study, specifically in those instances where a given cost was computed by different algorithms in two (or more) years. As a result, the documentation of Desmatics' findings is more complex than might otherwise be the case. The reader may expect frequent encounters with the phrases "for FY81," "for FY82," and "for FY83."

Desmatics has endeavored to have this volume reflect the current status of the depot level cost allocation algorithms within the WSSC system. The authors feel that this has been accomplished. However, the reader must realize that should future WSSC system changes impact on the algorithms discussed, portions of this report may become outdated.

Section II of this report provides a background discussion of the organizations within the Air Force which perform these depot-related functions. Process descriptions and qualitative evaluations for each of these four categories are presented in Sections III through VI. Section VII contains a description of an analysis of depot data that was undertaken by Desmatics in identifying processing errors in the FY81 WSSC production run. The final section of this report summarizes all the Desmatics findings with respect to depot activities.

II. BACKGROUND

The Air Force has five centralized CONUS Air Logistics Centers (ALCs). They are:

Ogden ALC (Hill AFB, UT)

San Antonio ALC (Kelly AFB, TX)

Sacramento ALC (McClellan AFB, CA)

Warner Robins ALC (Robins AFB, GA)

Oklahoma City ALC (Tinker AFB, OK).

The ALCs, operated by the Air Force Logistics Command (AFLC), provide centralized repair facilities for aircraft, missiles, ground communications-electronics and other types of Air Force systems. They have functional responsibilities that are implemented by four directorates. The Directorate for Maintenance oversees the area of depot maintenance including airframe and component repair, modification, overhaul, inspection, and support equipment maintenance. The remaining three directorates, the Directorates for Procurement, Materiel Management and Distribution, manage the parts pipeline for both depot and base-level maintenance programs.

The depots are specialized, with each depot servicing specified MDSs and maintaining certain classes of components. Because the ALCs operate in support of the field organizations, aircraft maintenance costs incurred in their operation are allocated by WSSC among relevant command aircraft down to the command-base-MDS level.

WSSC displays operating and support costs, in either the Air Force detail or CAIG report formats, for four depot-related functions: depot

maintenance, general depot support, depot installation support, and sustaining investment (see AFR 400-31, Vol. II [12]). Depot maintenance, which is performed primarily at centralized facilities, includes maintenance and modification of Air Force weapon systems.

WSSC also reports the costs incurred in the supply system that oversees procurement, warehousing and distribution of parts required by the maintenance function. These costs are displayed as general depot support costs. In addition, WSSC is concerned with the overhead costs associated with depot operations. WSSC identifies a portion of the installation support costs of the facilities where the depots are located as depot installation support and allocates shares of this cost to mission aircraft.

Materiel needed to replenish stocks depleted through the condemnation of materiel which is unsuitable for repair is one facet of sustaining investment. Another significant aspect of sustaining investment is the cost of acquiring modification kits needed to achieve acceptable safety levels, overcome mission capability deficiencies, reduce maintenance costs or improve reliability.

III. DEPOT MAINTENANCE

Aircraft depot maintenance includes maintenance or modification of aircraft, components or related support equipment performed at centralized USAF repair depots, at designated contractor facilities, or at organizational or intermediate facilities by specialized Air Force or contractor field teams and/or depot interservice support. The depots are able to provide more extensive shop facilities and equipment, and more highly skilled personnel than are usually available at lower echelons of maintenance. Depot maintenance activities consist of inspection, test, repair, modification, alteration, modernization, conversion, overhaul, reclamation and rebuilding of parts, subassemblies, assemblies, components, equipment and weapon systems.

A. PROCESS DESCRIPTION

The WSSC system obtains certain types of depot maintenance cost data from the Weapon System Cost Retrieval System (WSCRS), H036C, and displays these costs by MDS in the USAF detail and CAIG format reports. WSCRS produces cost data which is identified by MDS, but in order to include depot maintenance costs in the CMD/GELOC/MDS version of the WSSC history file, it is necessary for WSSC to allocate the MDS-level costs to the CMD/GELOC level. This is accomplished using allocation ratios based on flying operations data obtained from AVISURS (G033B) system.

Depot maintenance costs obtained from WSCRS are identified by Work Breakdown Structure (WBS) codes and types of expense, in addition to MDS.

The WBS codes used in the WSCRS data passed to WSSC are shown in Table 1. The types of expense used by WSSC are shown in Table 2, which also indicates the categories of WSCRS depot maintenance costs included in each WSSC type. These types of costs apply to each of the WBSs listed in Table 1.

It should be noted that for FY81 WSCRS provided a tailored file of depot maintenance and operations cost data to WSSC which contained an extensive number of cost categories, each record being identified by standard MDS and Work Breakdown Structure (WBS) code. In addition to direct labor costs, WSCRS identifies several categories of funded and unfunded costs for materiel, overhead, general and administrative (G&A), and other costs. WSSC selects only the direct labor and the funded types of other costs for use in computing aircraft depot maintenance costs from the cost data received from WSCRS. Funded costs, according to the WSCRS User's Manual [10], are those for which the depot will be reimbursed by the organizations for which the services were rendered. (Unfunded costs are those financed by other than depot maintenance appropriations or activities.) A more extensive discussion of depot maintenance funding and a description of depot maintenance costs is found in the Cost Information Handbook on Depot Maintenance [1].

For FY82 processing WSSC utilized an extract from the H036C data base rather than the tailored output file employed during FY81 processing. Also WSSC did not include funded G&A costs in FY82 because these costs are fixed, whereas WSSC was intended to portray only variable cost elements.

WSSC uses a particular combination of the WBS-coded costs from WSCRS to create the USAF history files and a different combination of

WSCRS WBS Code	Cost Category
AX1	Airframe Maintenance (includes PDM and Depot Modifications)
AX2	Aircraft engines and engine component maintenance
AX3	Other aircraft components maintenance
AX4	Aircraft avionics accessories maintenance
AX5	Aircraft armament maintenance
AX6	Aircraft support equipment maintenance

Table 1: Work Breakdown Structure Codes Used with Depot Maintenance Costs Passed from WSCRS to WSSC

WSSC Cost Type	WSCRS Cost Types Included
Military Direct Labor	Military Direct Labor
Civilian Direct Labor	Civilian Direct Labor
Other Labor Costs	Funded Operations Overhead Funded General and Administrative* Funded Maintenance Support Funded Other Direct Cost
Material Costs	Funded Direct Material
Contract Costs	Contract or Interservice Cost
Government Furnished Services	Funded Government Furnished Services
Government Furnished Material	Government Furnished Material

*FY81 only

Table 2: Types of Depot Maintenance Costs Used by WSSC, Showing the Types of Costs from WSCRS Included in Each Category

these WBS codes to produce the DOD (CAIG) history file. Table 3 shows the four categories of depot maintenance costs displayed in the USAF detail report, indicating the WBS codes and the nature of the costs included in each. These four categories constitute the rows of the depot maintenance cost display in this report. The columns are essentially the same as the items listed in Table 2, except that government-furnished services and materiel are included with contract costs under the heading of "contract," as shown in Table 4.

Costs are combined and displayed somewhat differently in the CAIG report produced by WSSC. The five subcategories of depot maintenance costs used are shown in Table 5, which indicates the WBS categories and costs included. Expense types also differ from those used in the USAF detail format. All labor categories (military, civilian and other labor costs) are combined into the single heading "depot labor," and government-furnished materiel costs are displayed as a separate heading.

As described in AFR 400-31, Volume II [12], allocation of depot maintenance costs to the command-base-MDS level is accomplished using flying operations ratios. In these ratios the numerators are the flying hours and possessed hours for each unique relevant CMD/GELOC/MDS, and the denominators are the worldwide flying hours and possessed hours for the same MDS. Each allocation ratio, AR, is given by:

$$AR = 0.5 \left[\frac{FH(CMD/GELOC/MDS)}{\text{Worldwide } FH(MDS)} + \frac{PH(CMD/GELOC/MDS)}{\text{Worldwide } PH(MDS)} \right] .$$

AFR 400-31 reports that the elements of depot maintenance cost at the worldwide MDS level are allocated using the allocation ratio above.

USAF Detail Cost Category	WBS-Code	WSCRS Costs Included
PDM and modifications	AX1	Airframe Maintenance, including: Programmed Depot Maintenance Depot Modifications
Engine maintenance	AX2	Aircraft Engines & Engine Components
Avionics maintenance	AX4	Aircraft Avionics Maintenance
Other depot maintenance	AX5	Aircraft Armament
	AX6	Aircraft Support Equipment
	AX3	Other Aircraft Components

Table 3: USAF Detail Report Depot Maintenance Cost Categories, Showing WBS Codes and Costs Included

USAF Detail Cost Type	Costs Included
Materiel	Depot Maintenance Funded Direct Materiel
Contract/interservice support	Government Furnished Services
	Government Furnished Materiel
	Contract Services
Other	Funded Operations Overhead
	Funded General and Administrative (FY81 only)
	Funded Maintenance Support
	Funded Other Direct Cost
Airmen P&A	Military Direct Labor
Civilian P&A	Civilian Direct Labor

Table 4: Types of Costs Displayed in the WSSC USAF Detail Report, Indicating Costs Included in Each Type.

CAIG Format Cost Category	WBS Code	WSCRS Costs Included
Airframe Rework	AX1	Airframe Maintenance, including: Programmed Depot Maintenance Depot Modification
Engine Rework	AX2	Aircraft Engine & Engine Components
Component Repair	AX3	Other Aircraft Components
Support Equipment Repair	AX6	Aircraft Support Equipment
Other Depot Repair	AX4	Aircraft Avionics Accessories
	AX5	Aircraft Armament

Table 5: CAIG Report Depot Maintenance Cost Categories, Showing WBS Codes and Costs Included

Actually, WSSC processing uses a two-stage allocation involving a "relevant-all" ratio described in the WSSC systems specifications [9] and discussed in Volume I [5] of this series of Desmatics reports.

B. QUALITATIVE EVALUATION

The previous section provides a description of the procedures used by WSSC to produce the depot maintenance costs for FY81 and FY82. It is based on the original system design which called for allocation of costs, available at the worldwide MDS (all command) level, down to the relevant CMD/GELOC/MDS level using flying operations ratios.

The use of these ratios as the basis for allocation of aggregated costs to a more detailed level is in general a technique to be used only where more direct identification of costs is not possible. If such ratios are used, Desmatics believes that they can be improved. (See the assessment of allocation based on flying operations which is discussed in Volume I [5] of this series of reports.)

The Office of VAMOSC has developed an enhancement for WSSC which has the potential of providing more precise information of depot maintenance cost categories. This is possible because costs which were originally identified by six WBS codes are now able to be identified by the following nine WBS group codes: (1) aircraft overhaul (AF), (2) engine overhaul (EO), (3) engine accessories (EA), (4) aircraft accessories (AA), (5) avionics instrumentation (VI), (6) avionics communication (VC), (7) avionics navigation (VN), (8) armament (AR), and (9) support equipment (SU).

Depot maintenance cost data input to WSSC is subject to the allocation logic used by WSCRS and to the data limitations and constraints set forth in the WSCRS Users Manual (AFLC Manual 173-264) [10]. First of all, WSCRS deals with aircraft components, many of which are items common to two or more aircraft MDSs. In such cases WSCRS prorates costs among applicable MDSs either on the basis of usage (FH) or inventroy (PH) depending upon whether or not the item's requirements were computed on inventory. Details of the allocation algorithms used by WSCRS are outlined in Chapter 5 of the WSCRS Users Manual, where it is pointed out that the allocation factors used by WSCRS do not take into account the peculiar effects that different missions, numbers of sorties, climate, and other environmental factors may have. This caveat, of course, applies equally well to all WSSC allocations which are based on inventory and usage ratios. Additional limitations are set forth in the WSCRS documentation.

Although it is not within the scope of the current Desmatics research to delve deeply into the WSCRS system at this time, there are no indications that WSCRS input to WSSC suffers any serious inadequacy, despite the constraints described in the WSCRS documentation. Recent studies [6,7] regard WSCRS as a valuable depot maintenance data source that is an improvement over earlier sources. Nonetheless, an in-depth examination of the WSCRS logic is warranted and will be undertaken at a later date under an added contract task.

In addition to switching the allocation basis from flying operations data to use of completions ratios, the planned enhancements for depot

maintenance include the separation of costs for modification (mod) kit installations from the costs reported for programmed depot maintenance (PDM). This is to be accomplished by identifying the costs for class IV and V modifications using information from the G079 system, by MDS, and subtracting them from the airframe depot maintenance costs obtained from WSCRS (which includes costs for mod kit work done during PDM). This change will enable WSSC to report PDM costs cleanly. Furthermore, if the mod kit installation costs thus identified are then reported in a separate "modification" category, this should bring WSSC into close alignment with CAIG specifications which call for separate visibility of these costs.

IV. GENERAL DEPOT SUPPORT

In addition to the maintenance function, depots also house the organizations that handle and manage the supply of spare and repair parts used in maintenance activity. The supply functions are performed by three organizations:

1. Directorate for Procurement
2. Directorate for Materiel Management

and 3. Directorate for Distribution.

These are the non-maintenance directorates at the ALCs.

Costs incurred by these supply organizations are reported on the USAF detail display as general depot support costs. On the CAIG report format they are reported as a subcategory of depot non-maintenance costs. Guidelines provided by CAIG list the activities that are subsumed in this category. They include: (1) procurement of supplies, spares and repair parts, and management of these activities; (2) filling requisitions for supplies, spares and repair parts including receiving, storing, inspection and packing; (3) technical and engineering support; and (4) producing and maintaining publications and technical orders necessary to support the weapon system.

A. PROCESS DESCRIPTION

Costs for general depot support are contained in the ABDS (H069R) file. In WSSC processing, records having the following PEC codes are selected:

71111 - Supply Operations (Directorate of Distribution)

71112 - Inventory Control Point Operations (Directorate of Materiel Management)

71113 - Procurement Operations (Directorate of Procurement)

Selected cost records are further identified by EEICs for officer, enlisted and civilian pay and allowances, contract, materiel and miscellaneous expenses.

General depot support costs represent the expenses incurred for managing all types of items including both aircraft-related and other parts. Therefore, WSSC must first separate the aircraft share of the expenses before allocating them among MDSs. To do this WSSC computes a depot directorate factor (DDF) for each depot from data supplied by HQ AFLC/MMMA. The DDF is a ratio of dollar values for managed items:

$$DDF = \frac{\text{Dollar value of aircraft-related items managed}}{\text{Dollar value of all items managed}} .$$

For each depot, the selected costs are multiplied by the appropriate factor. The result is the aircraft share of the total cost for the three supply directorates. These costs are then summarized across depots to the worldwide level. The worldwide depot supply costs are then allocated to the command-base-MDS level using flying operations data. The allocation ratio (AR) is in the form:

$$AR = 0.5 \left[\frac{FH(CMD/GELOC/MDS)}{\text{Worldwide FH}} + \frac{PH(CMD/GELOC/MDS)}{\text{Worldwide PH}} \right]$$

Throughout the allocation, the worldwide figures include both relevant and non-relevant command aircraft.

B. QUALITATIVE EVALUATION

The processing algorithm for general depot support costs has been extensively reviewed by personnel at the Office of VAMOSC. Desmatics has had extended discussions with VAMOSC personnel regarding the FY81 and FY82 algorithms and possible alternatives. The evaluation presented here represents a summary of those discussions with some additional points for consideration.

The WSSC criteria for selecting cost data for this process were reviewed. AFR 300-4 [11] was referred to in order to confirm that WSSC is selecting appropriate PEC codes. While the definitions in AFR 300-4 appear somewhat ambiguous with respect to the functions described in CAIG, the Office of VAMOSC has established that the selected PEC codes do correspond to the three supply directorate functions and that these in turn fulfill CAIG requirement [3].

It should be noted that while the Aerospace Guidance and Metrology Center (AGMC) at Newark, Ohio, performs depot maintenance, unlike the ALCs it has no aircraft parts procurement, materiel management or supply responsibilities. Costs for these activities are, in general, not reported against the AGMC. WSSC documentation should be changed to reflect this situation.

A review of the functions that the three directorates perform showed that they are different to the extent that costs are driven by different factors. Therefore, it is inappropriate to apply the same allocation process to each directorate's cost figures. For example, the Office of VAMOSC has postulated that the functions of the Directorate

for Distribution are related more to the volume of parts handled than to the value of those parts. That is, the functions included in this directorate generate expenses essentially equally for all parts regardless of their value. On the other hand, they suggest that Directorate for Materiel Management costs may be driven by the dollar value of the parts managed. The functions performed by this organization apparently are such that more expensive items receive more attention and therefore generate greater costs. The activities of the Directorate for Procurement include management of contracts to procure parts. The Office of VAMOSC has hypothesized that costs for these activities are driven by the dollar value of procurement contracts administered.

Determination of the aircraft portion of costs for the three directorates should take into account the differences in functions and cost drivers. In each case the allocation ratio that is applied to the depot cost figures should use data that measures these cost drivers. In the case of the Directorate for Materiel Management (PEC 71112), the current allocation ratio using the dollar value of aircraft parts managed uses data consistent with the proposed cost drivers.

If the costs for the Directorate for Procurement (PEC 71113) are driven by contract management functions, both the volume and the dollar value of the procurements should be considered cost drivers. A review of the Data Systems Assignments and Status Master List (P040E) [2] suggests that the Acquisition and Due In System (J041) and Automated Purchase System (J023) be considered as possible data sources for an allocation ratio to factor the aircraft related share of the costs. Further study is necessary to determine what data could be available for WSSC

and how it relates to the functions performed and costs generated.

If the aircraft share of Directorate of Distribution Costs (PEC 71111) is driven by the volume of parts managed, then a ratio of the number of aircraft parts managed to the total number of parts managed could be computed. Data on number of parts managed is available for many items from HQ AFLC/MMMA, and a portion of the costs may be factored using this data. The remainder may be estimated using other data such as the dollar value of aircraft parts managed.

For each directorate, costs are computed at the depot level. These costs must be summarized across directorates to the worldwide level before being allocated to the command-base-MDS level. Currently, WSSC uses flying operations data to perform this allocation. The relationship is very indirect between base level weapon system inventory and level of flying activity on one hand, and worldwide depot materiel handling expenses on the other. The Office of VAMOSC is considering using data on depot completions and/or NRTS (not reparable this station) actions. The former is a measure of depot maintenance required on the weapon system airframe. NRTS actions are initiated at the base and pertain to weapon system components. In both instances command, base and MDS visibility can be achieved. These variables may provide a better indication of the extent to which depot supplies have been used by each command-base-MDS. Desmatics suggests that feeder systems supplying this potentially useful data be studied more closely. If data could be made available in the future, a quantitative assessment of their utility could be made.

Unfortunately, the portion of depot supply costs that relates to consumable parts is not considered when only completions and NRTS actions

are used. This may be unavoidable since there is no way to get MDS identification on common consumable parts.

V. DEPOT INSTALLATION SUPPORT

The costs for depot installation support represent the overhead costs of operating the depot facilities. These costs are reported in three subcategories: real property maintenance (RPM), communications (COM) and base operating support (BOS). They parallel the costs incurred and displayed for base-level installation support. (See Volume II [5] of this report series.)

Several of the topics discussed regarding base-level installation support costs apply to depot installation support costs as well. First, they are overhead costs incurred in support of the depot facility. They are only indirectly related to the support of aircraft. Second, they are shared or common costs, in that depot activities serve non-aircraft missions as well as the aircraft mission. To that extent, all missions should share the overhead burden in a manner that attributes costs in proportion to service. Third, the portion of the costs attributable to the aircraft mission is common among MDS's and must be apportioned appropriately.

However, depot installation support costs are not identified directly by mission or MDS, but must be obtained by allocation. WSSC acquires installation support cost data from the ABDS system for each of the bases at which ALCs are located and for Newark AFS at which the AGMC is located. These costs represent support provided to all tenants, including the depot, i.e., the ALCs or the AGMC. WSSC determines the depot share through an allocation which assigns installation support costs in proportion to the number of personnel in the depot relative to the base population. This depot share is really in support of all depot-related activities,

including aircraft, missiles and other systems, so it is necessary to identify a subset of these costs which is the aircraft portion. Then it is necessary to allocate the aircraft portion among the specific aircraft weapons systems at the MDS level.

A. PROCESS DESCRIPTION

In order to determine the costs that ultimately are attributed to each MDS, WSSC performs a two-step allocation. The first step is designed to identify the aircraft share of the depot installation support costs for each ALC and for the AGMC. To do this, WSSC uses a two-part factor which is applied to the installation support costs of the host base. The first part is a ratio of the depot maintenance strength (DMS) to the base population (POP) of the host base. The second part is a ratio of the depot maintenance direct labor hours spent on aircraft (ACDLH) to the total of all depot maintenance direct labor hours (DMDLH) expended. A separate factor is calculated for each of the five ALCs and for the AGMC, in the form:

$$\text{Depot Factor} = \frac{\text{DMS}}{\text{POP}} \times \frac{\text{ACDLH}}{\text{DMDLH}} .$$

These six depot factors, identified by the GELOC code of the host facilities where they are located, are calculated manually and are then stored in a depot factors file for use by the VAMOH system in processing the cost records obtained from the ABDS system.

Installation support cost records from the ABDS file are selected by

VAMOH on the basis of CMD, RC/CC and PEC. Table 6 shows which are selected. Costs within these records are further broken down on the basis of Element of Expense/Investment Code (EEIC) for materiel, contract, other and officer, airman and civilian pay and allowances. Table 7 indicates which EEICs are selected and how they are classified. The selected costs are those incurred at the GELOC for the depot and other tenants. Each ABDS record that has a GELOC which matches any of the records in the depot factor file has the corresponding factor applied to the amount and is written on the output file. The costs thus determined are summed by WSSC over the five ALCs and the AGMC to provide a worldwide pool of depot installation support costs which are subsequently allocated to the supported aircraft weapon systems.

The second step of the procedure is to allocate the aircraft mission depot installation support costs to a given command-base-MDS combination, for which WSSC uses a ratio computed from flying operations data. This ratio (AR) represents a composite measure of the flying activity and the inventory level for the given MDS operated by a relevant command at a specific base, relative to the totals for all Air Force MDSs in all commands.

The form of this ratio is:

$$AR = 0.5 \left[\frac{FH(CMD/GELOC/MDS)}{\text{Worldwide FH}} + \frac{PH(CMD/GELOC/MDS)}{\text{Worldwide PH}} \right] .$$

A separate ratio is computed for each command-base-MDS.

The worldwide depot installation support costs are then allocated among the command-base-MDSs using these ratios. Although costs for depot and below depot installation support are displayed separately in the

PEC	RC/CC	COST CATEGORY
XXX94	------	Real Property Maintenance
XXX95	------	Communications
33112	XX26XX	
	XX38XX	
35114	XX26XX	
	XX38XX	
XXX96	------	Base Operating Support

Note: Only LOG, SYS, CSV, TAC, SAC, MAC, ATC, AAC, AFE or PAC command records are accepted.

Table 6: Selection of Depot Installation Support Costs

EEIC	Type of Expenditure
20101	Officer Pay
20102	Airman Pay
391XX-394XX, 396XX	Civilian Pay
51XXX-59XXX	Contract
60XXX-63XXX	Materiel
All Other	Other Cost

Table 7: Element of Expense/Investment Codes (EEIC) and Accounts Used in Depot Installation Support

USAF detail report, they are added together for presentation in the CAIG report.

B. QUALITATIVE EVALUATION

Several of the points discussed in the evaluation of the base level installation support process are also pertinent to depot installation support processing. One such consideration relates to the concept of a fixed portion of support costs. In terms of weapon system costing, only the marginal, incremental costs should be included. A portion of the indirect overhead cost of operating a depot facility is fixed and is required regardless of tenant activity or base size. It is this fixed portion of the costs which, if it can be identified, should be excluded from allocation.

The methodology for identifying the fixed costs was discussed in Volume II. In that discussion it was posited that a general relationship exists between installation support costs and the number of people that are supported. The purpose of the procedure that was proposed was to define that relationship in terms of a regression equation and thereby determine the fixed costs for each installation. It can be argued, however, that the installations at which there is a depot tenant will not conform to the relationship that exists for other bases. The regression approach is currently under investigation by Desmatics; the findings will be reported in Volume VII of this series.

Application of the proposed method to depot installation support

requires data on total base population, base installation support strength and total base installation support costs. The algorithm fits a regression equation to points identified by total costs and the number of supported people for each base. In this case, the regression equation would be computed to fit points defined by the bases at which the five depots and the AGMC are located. The steps for calculating the fixed and variable portions of the total costs are the same as given in Volume II.

Several constraints would apply if this computation were implemented for this process. The first is that with only five or six points (depending on whether data is available for the AGMC) it will be more difficult to define a satisfactory regression equation. If the bases under consideration form a cluster with insufficient spread in strength or cost observations, it may not be possible to fit an equation. Two other constraints, discussed in Volume II, also apply: (1) it must be assumed that while fixed costs may vary among bases, increments in costs due to the variable components are incurred according to one general relationship; (2) it must be assumed that base-to-base variations in fixed costs are small when compared with variations in total installation support costs.

One last consideration regarding identification of fixed costs is that it be done prior to any other allocation or factoring. The fixed costs are independent of the kinds of tenants at the base. Therefore, the regression procedure must be implemented before all the depot and aircraft mission shares are identified and should include all costs for the GELOC.

The remaining points to be discussed relate to the ratios used to partition the aircraft mission share of the costs and to distribute costs among the MDSs. As discussed in Volume II, installation support costs are largely driven by the number of production personnel who are supported and are the beneficiaries of the support activity. In this case, the production workers are the depot maintenance personnel. The factor currently used by WSSC calculates the aircraft-related portion of the total population that are maintenance personnel. As was noted in Volume II, when the total population is used in the denominator of the factor, it in essence attributes some portion of the support costs to support people. Desmatics recommends instead that the denominator equal the number of supported people at the depot (the total population less the installation support personnel).

Currently WSSC is using flying operations data to allocate costs from the depots to the command-base-MDS level. This assumes that a command-base-MDS consumes depot maintenance, and therefore depot installation support, in proportion to a composite measure of flying hours and possessed hours. While there is probably some degree of correlation of these activities, VAMOSC personnel have recently proposed using data that more directly indicates the extent to which a command at a base has utilized the depot facilities. This data provides measures of the number of completed jobs performed at the depot and the number of NRTS (not reparable this station) actions initiated at a base.

Completions data reflects the work done by a depot on a weapon system airframe, which may include PDM, inspections, rework, or modifications. NRTS actions indicate repair work requested by a base on weapon

system components. Both data sources can provide command-base-MDS identification. Because depot maintenance for components is organized functionally, it is not possible to associate an MDS with a depot as it is with airframe work, i.e., completions. Therefore, to use this data to allocate depot installation support costs to the command-base-MDS level, costs as well as NRTS and completion data would still need to be aggregated to the worldwide level. The question as to how to combine the two factors would be subject to the same considerations discussed in Volume I [5] regarding flying and possessed hours. It would seem worthwhile, however, for VAMOSC personnel to pursue this possible alternative.

Desmatics presents two additional suggestions for consideration by the Office of VAMOSC. The first is that VAMOSC personnel consider including depot installation support costs from all four directorates (and not just from the Directorate of Maintenance) at the ALCs, and that this larger cost then be allocated among MDSs. The rationale underlying this suggestion is that the ALCs serve two functions in the aircraft mission. One is to provide direct maintenance on aircraft and their subsystems. The other is to procure, manage and distribute spares and repair parts for aircraft maintenance. While the latter may be viewed as an overhead materiel handling function, because of its size (roughly one-half of the depot population) it in itself incurs substantial overhead expenses. It is suggested, then, that a portion of installation support costs for the GELOC be attributed to the depot supply functions and that an aircraft share of these costs be identified. The result would be added to the costs identified as being the aircraft share for the depot maintenance function for allocation to the MDSs.

To determine the appropriate share of installation support costs for the supply functions of the depot, additional allocation ratios would need to be defined. They would be analogous to those ratios applied currently to the maintenance directorate in that they would use a two-component factor to identify the aircraft share of the directorate's costs. The first component would be a strength ratio analogous to that described previously for the Directorate of Maintenance. The second component would be the corresponding directorate allocation ratio described previously for General Depot Support. (There would be a separate factor for each directorate at each depot.) The composite factor would be applied to the total base installation support costs. The resulting costs would then be allocated to the command-base-MDS level based on NRTS and/or completions ratios.

It was pointed out in the previous section that a depot factor is used to determine the portion of installation support cost which is charged for aircraft depot maintenance. This factor is based on two ratios: a strength ratio and a maintenance direct labor hour ratio. The former reflects the part of the base population in the Directorate for Maintenance. The purpose of the manhour ratio is to identify the part of depot maintenance which is devoted to aircraft maintenance. There is a problem with respect to the way the manhour ratio is computed.

WSSC computes a separate strength ratio for each individual depot, but computes a single, overall manhour ratio rather than using a separate manhour ratio for each depot. Desmatics recommends that separate ratios be used.

VI. SUSTAINING INVESTMENT

Sustaining investment, as defined by CAIG [3], includes "... the costs of procuring spares, modification kits and materiel, and support equipment needed to sustain deployed unit peacetime operations exclusive of WRM [war readiness materiel] costs." Further, CAIG indicates that replenishment spares "... are primarily procured to replace losses due to condemnations." Costs to increase inventories are included, but the costs of initial spares are not. Sustaining investment also includes the cost of modification kits procured to achieve acceptable safety levels, improve weapon system reliability, reduce maintenance costs or overcome mission capability deficiencies. (Kits to extend design concept mission capabilities are not included by CAIG as part of sustaining investment.)

WSSC currently displays the costs for modification kits and replacement spares in its report outputs but does not provide visibility for costs associated with replenishment of support equipment inventories. A major constraint in providing support equipment cost visibility is the fact that a large portion of support equipment is not peculiar to any single MDS. Furthermore, procurements of support equipment are currently not reported to WSSC in a manner that shows what equipment was bought. Since flying operations data was not considered to be a satisfactory basis for allocating support equipment replacement costs to individual weapon systems, WSSC currently includes only replenishment spares and modification kits within the sustaining investment cost category.

A. PROCESS DESCRIPTION

For FY81 WSSC obtained sustaining investment cost information from a special file of AFLC ABDS mods and spares cost data. This file contained both mods records and spares records, each identified by Budget Program Activity Code (BPAC), Materiel Program Code (MPC), and fiscal year code. Records having a BPAC of 11XXX and an MPC of 2000 identified modification kit expenditures, while records having a BPAC of 15XXX and an MPC of 2200 identified replenishment spares expenditures. Only records having a balance indicator code of "E" (indicating an accrued expenditure paid) were accepted.

FY81 expenses reported to WSSC from ABDS represent a year-end figure for costs that accumulated over a period of several years. In order to reconstruct the expenses incurred for FY81, WSSC subtracted the previous year's ending balance from the FY81 year-end figure. A table was then used to identify FY81 mods and spares expenditures by MDS at the world-wide level. Starting in FY82 WSSC obtained replenishment spares data from the H036C system, which reports costs for condemnations, both at base and depot, of components and subassemblies identified by MDS.

WSSC allocates mods and spares costs to the relevant command aircraft at each command/base using flying operations data. In the case of replenishment spares costs, WSSC uses an allocation ratio based on both possessed hours and flying hours as follows:

$$AR_S = 0.5 \left[\frac{FH(CMD/GELOC/MDS)}{\text{Worldwide } FH(MDS)} + \frac{PH(CMD/GELOC/MDS)}{\text{Worldwide } PH(MDS)} \right]$$

where the denominators represent the flying hours and possessed hours for a given MDS in all commands, while the numerators represent only relevant command data.

In the case of mod kit expenditures the costs are allocated among USAF relevant command aircraft on the basis of possessed hours only, using the following ratio:

$$AR_M = \frac{PH(CMD/GELOC/MDS)}{\text{Worldwide } PH(MDS)} .$$

B. QUALITATIVE EVALUATION

The Office of VAMOSC noted some problems with the FY81 process and thus made some changes for FY82. The principal problem is that the expenses reported to WSSC in FY81 from ABDS represented investment expenses. Money spent in the current year for spares and mod kits is for parts that may be used in this or future years. It does not represent costs of the current year's operation and support of a weapon system. Frequently, these expenditures follow a long-range investment program which does not distribute costs proportionately among MDSs for a given year. They do not always relate to the current needs of an MDS for repair or modification.

It should be noted that CAIG defines this category as an investment cost. In terms of life cycle cost estimations this is a suitable approach. WSSC's primary objective, however, is to keep an historical record of expenditures made in support of existing weapon systems. This record is generated in a format compatible with CAIG requirements so that historical costs can be compared with expected life cycle costs. Therefore, while

a change from investment cost reporting to historical reporting may seem to conflict with CAIG requirements. it is an appropriate change to make.

By switching to condemnations data from the WSCRS system, WSSC has overcome the problem of using investment dollars instead of historical cost data for FY82 and beyond. Condemnations more closely reflect the parts that have actually been used in the current fiscal year. However, use of this data poses other problems. Parts may be condemned at the time of replacement but they may also be condemned because they are no longer used or are never used. Inclusion of these latter two kinds of condemnations confounds the picture of the true condemnations that result from consumption of spares for weapon system operation.

It would be useful to know the extent to which reported condemnations represent a confounded picture rather than a true picture of consumption. Desmatics suggests that a survey of the depots be made to try to determine the extent of the problem, working toward possible development of a factor that could be used to adjust the reported condemnations so that a more accurate relationship of condemnations and consumption could be defined.

Eventually the procedure for computing modification kit costs may be revised to reflect historical consumption rather than investment stockpiling. One possibility being considered is the use of the System and Equipment Modification Program (G079), which provides data on modification completions and costs. These costs are available at the worldwide MDS level, but they may be allocated to the command-base-MDS level using depot modification completion data from the Depot Maintenance Requirements and Program Management System (G072E). The G072E data may be used to

compute ratios of the number of completions by CMD/GELOC/MDS to the total of all completions for the MDS. These ratios may then be applied to the modification kit costs by MDS obtained from G079. However, since the details of this process are still in development, it is premature to attempt to evaluate it.

The CSCS (D160B) system treats those TCTO Kits which are assembled at base level using components and material from base supply as a sustaining investment cost. Currently WSSC includes these items as a below depot maintenance materiel expense, rather than as part of sustaining investment. Desmatics recommends that WSSC pick up these costs from the D002A Supply Consumable Materiel files via the D160B system, include them as part of sustaining investment and subtract these amounts from below depot maintenance materiel expense.

Costs for ground support equipment (both peculiar and common) present a somewhat different problem. Because the input data does not contain MDS identification, WSSC currently does not attempt to provide cost visibility for support equipment in its reports. Until a more suitable data source can be found, Desmatics suggests the following interim solution.

In several ways ground support equipment (GSE) costs are analogous to depot installation support or general depot support. They are incurred for aircraft and other missions (such as for missile operation) and they are shared among MDSs. Allocation of these costs may be made analogously to the allocation of depot installation support or general depot support.

One approach, which is dependent on the availability of data, would

be to accumulate the aircraft portion of worldwide costs for GSE, which corresponds to a BPAC of 12XXX. An estimate of these costs attributable to a given MDS could be based on the total direct labor dollars (DL$) expended on maintenance of that MDS (at depot and below-depot levels) relative to worldwide aircraft maintenance labor costs.

The use of DL$ instead of direct labor hours in the suggested allocation would have the advantage of reflecting the generally higher hourly rates at the depot. Thus, allocation to a specific command-base-MDS would be based on the allocation factor

$$AF = \frac{\text{CMD/GELOC/MDS Maintenance DL\$}}{\text{Aircraft Worldwide Maintenance DL\$}}$$

$$= \frac{A_1 + A_2}{B_1 + B_2}$$

where

A_1 = CMD/GELOC/MDS base-level maintenance DL$

A_2 = CMD/GELOC/MDS depot-level maintenance DL$

B_1 = Aircraft worldwide base-level maintenance DL$

B_2 = Aircraft worldwide depot-level maintenance DL$.

The values of both A_1 and A_2 may be obtained directly from the WSSC output files, while the value of B_1 may be obtained from ABDS and that of B_2 from WSCRS. The GSE costs allocated to the CMD/GELOC/MDS would be given by applying the appropriate AF factors to the BPAC 12XXX costs, i.e.,

GSE Costs (CMD/GELOC/MDS) = (BPAC 12XXX Costs) x AF .

GSE costs allocated to a given MDS would, of course, result from summing

up the allocated costs for that MDS over all relevant commands and bases.

It is realized that a constraint on this allocation approach is that it lumps peculiar and common support equipment together. However, currently there does not appear to be a way in which each type could be addressed individually.

VII. ANALYSIS OF SOME DEPOT DATA

The previous sections of this report have provided a qualitative assessment of the four depot-related cost categories in the WSSC system. This section addresses quantitative aspects of these cost categories and the associated WSSC processing. The findings described here should provide the Office of VAMOSC with useful information for evaluation of the WSSC system. Specific topics addressed are certain FY81 WSSC processing anomalies and their effects on the FY81 output.

A. IDENTIFYING SOME WSSC AND VAMOH PROCESSING ANOMALIES

Pursuant to its suggestion that a fixed portion of depot installation support costs be identified for exclusion from processing, Desmatics reviewed the FY81 costs reported by the five depots. Cost data was provided to Desmatics for this review in a copy of the Consolidated Base and Depot BOS Costs file, WSSC format C-24 (WC-24). According to specifications, this file contains installation support costs that have been summarized to the EEIC-PEC code level within GELOC code. Dollar amounts in this file are factored by VAMOH [8] to establish the aircraft portion of the costs for each EEIC-PEC-GELOC combination. For those GELOCs where depots are tenants, there are two records output for each PEC code. One represents the aircraft share for the depot support costs. The other represents the aircraft share for the "base" support costs. (In this case "base" refers to the subset of the costs for the GELOC that are attributed to a relevant command flying tenant.) These two records are created by

multiplying ABDS input dollars by a depot factor and a base factor, respectively.

In developing a regression equation for the costs for the five depots, Desmatics started with the factored costs which had been output by VAMOH and worked backwards to derive the dollar amounts input to the VAMOH system. Dividing the factored depot costs (output from VAMOH) should have yielded the total of the input dollars. Likewise, dividing the factored base costs by the corresponding base factors (contained in the BOS/WSSC file) should have yielded a similar result except in the case of base communications. These latter costs also include some unfactored costs for air traffic control activities in addition to the factored communications costs.

However, when Desmatics worked backwards from the factored depot and base costs using FY81 WC-24 data, BOS/WSSC factors, depot factors supplied by the Office of VAMOSC and air traffic control costs, the results were different for all three categories of installation support.

Desmatics then proceeded to isolate the problem using the WC-24 data. Totals were accumulated across EEICs from WC-24 for each category of support costs for each depot location. For simplicity, only data for Tinker AFB will be shown. Because of the nonfactored portion of communications costs, these will not be discussed here, although they were found to present the same problem.

Tinker	Base Costs (WC-24)	Depot Costs (WC-24)	Ratio
RPM	$3,450,590	$14,245,178	.2422
BOS	$3,963,518	$16,363,916	.2422

It should be noted that RPM costs and BOS costs are in a constant ratio when base and depot costs are compared. This relationship held for the other ALC locations as well.

Simple algebraic manipulation shows that the ratio of these costs should equal the ratio of the base and depot factors that were applied to the VAMOH-selected ABDS input.

(1) RPM$(base) = RPM$(GELOC) x (base factor)

(2) RPM$(depot) = RPM$(GELOC) x (depot factor)

Dividing equation (1) by equation (2) yields:

$$\frac{\text{RPM\$(base)}}{\text{RPM\$(depot)}} = \frac{\text{base factor}}{\text{depot factor}} .$$

Unlike the ratio of dollars shown above, which was .2422, the ratio of the factors was

$$\frac{.1087}{.344} = .3160 .$$

In trying to explain this discrepancy, Desmatics then took steps to investigate the processing that produced WC-24. This file is the product of a WSSC routine that reads the ASO-WSSC-Expended Dollars file, VAMOH format C-30 (VC-30), a VAMOH file of factored costs. WSSC selects costs from VC-30 for processing in different cost categories and sums installation support costs within PEC code for each GELOC, creating two WC-24 summary records for GELOCs that have had both factors applied. Desmatics reproduced the logic described in the WSSC system specifications and confirmed that the summarized costs in WC-24 represent the sums of VC-30 data.

At this point it was apparent that the problem lay in the VAMOH process that selects ABDS records for WSSC processing and applies the base and depot factors to the installation support records. The Office of VAMOSC then determined that a test file of depot factors had inadvertently been used for the production run. Therefore, instead of using the factors computed for production, VAMOH used test factors and produced erroneous results. Table 8 shows what factors were used versus what were intended to be used.

When Desmatics was provided the list of depot factors actually used in VAMOH, a check was made to confirm that working backwards from the base and depot reported costs, dividing the two types of output costs by their appropriate factors, would yield identical cost figures. These results would be equivalent to the sum of the raw data that was input to the factoring process.

Desmatics found that in all cases except communication costs for Warner Robins ALC, the results were as expected. When the total Robins AFB communication costs were computed using the factored depot costs, the results were higher than when computed from the base costs. Desmatics relayed these findings to the Office of VAMOSC who then traced this problem back to the VAMOH program that factors ABDS costs. Because the AGMC (Newark AFS, OH) did not have an entry in the FY81 BOS/WSSC file but did have a depot factor file record, the program logic treated all AGMC ABDS records as belonging to the depot communications costs for Warner Robins. Therefore, factored depot communications costs for Warner Robins were inflated by the amount of factored depot installation support costs for the AGMC, approximately one million dollars. In addition then, no costs ap-

	Depot Factor Used	Depot Factor Intended
Ogden ALC (Hill AFB)	.450	.328
San Antonio ALC (Kelly AFB)	.180	.413
Sacramento ALC (McClellan AFB)	.720	.369
Warner Robins ALC (Robins AFB)	.300	.317
Oklahoma City ALC (Tinker AFB)	.450	.344
AF Guidance and Metrology Center (Newark AFS)	.100	.595

Table 8: Depot Factors Used for Depot Installation Support Processing versus Depot Factors Intended for Use

peared in the output for AGMC installation support.

B. EFFECTS OF PROCESSING ANOMALIES ON THE WSSC OUTPUT

The question of the impact of these problems on WSSC results was addressed next. The erroneous inclusion of AGMC costs with Warner Robins depot communication costs means that on a worldwide level, communications costs were overstated, while real property maintenance and base operating support costs were understated. The FY81 total, however, was unaffected.

As Table 9 indicates, the use of the incorrect depot factors produced a reported worldwide total of $151.7 million, as opposed to the actual total of $130.2 million. Thus, the effect of using the wrong depot factors was a $21.5 million overstatement of worldwide depot installation support costs, of which $15.3 million was allocated to the relevant commands. Therefore, this overstated cost figure was allocated to the relevant CMD/GELOC/MDS level. The figures presented in Table 9 reflect the costs as they were reported versus the costs as they were actually incurred. These problems were brought to the attention of the Office of VAMOSC, which corrected them for the FY82 production run.

	Real Property Maintenance	Base Communications	Base Operating Support	Total
Ogden ALC				
Actual	9.895	1.344	11.424	22.664
Reported	13.558	1.842	15.653	31.053
Overstated	3.663	.498	4.211	8.389
San Antonio ALC				
Actual	8.641	2.110	13.638	24.390
Reported	3.766	.919	5.943	10.630
Overstated	- 4.875	- 1.191	- 7.695	- 13.760
Sacramento ALC				
Actual	11.249	1.808	12.401	25.460
Reported	21.950	3.529	24.198	49.678
Overstated	10.701	1.721	11.797	24.218
Warner Robins ALC				
Actual	8.532	1.477	11.987	21.998
Reported	8.074	1.398*	11.345	20.818*
Overstated	- .458	- .079	- .643	- 1.180
Oklahoma City ALC				
Actual	10.919	6.040	12.542	29.502
Reported	14.246	7.880	16.363	38.490
Overstated	3.327	1.840	3.821	8.988
Newark AFS **				
Actual				6.171
Reported				1.037
Overstated				- 5.134
Worldwide				
Actual	49.239	12.781	61.995	130.190***
Reported	61.596	15.570	73.504	151.710***
Overstated	12.357	2.788	11.509	21.520***

* AGMC dollars have been subtracted from these figures.

** AGMC dollars are not identified by PEC code in the data available to Desmatics.

*** Grand totals are for total column only, since AGMC category amounts were not available.

Table 9 : Actual Versus Reported Depot Installation Support Costs (in millions of dollars)

VIII. CONCLUSIONS, RECOMMENDATIONS AND OFFICE OF VAMOSC COMMENTS

This volume has presented an evaluation of WSSC cost allocation algorithms for four depot-related areas of O&S cost: depot maintenance, general depot support, depot installation support, and sustaining investment. As a part of this evaluation Desmatics has made a number of suggestions for consideration by the Office of VAMOSC.

A. SUMMARY

Changes are under consideration for the algorithms used by WSSC to allocate costs in each of the four depot categories, but the final form of the changes has not been fully established. Moreover, the majority of the changes suggested would involve the use of alternative data systems, making it difficult for Desmatics to assess their potential effectiveness. However, the proposed enhancements appear to represent a step in the right direction, in that they seek to provide a more direct, appropriate and functionally-related basis for allocation.

B. RECOMMENDATIONS AND REPLIES

The following summarizes the most significant of Desmatics' observations and conclusions with respect to the four areas of depot-related costs. These are presented in itemized format with respect to the four cost categories. The responses provided by the Office of VAMOSC are also included.

1. Depot Maintenance Cost Identification (See pages 13-15)

Conclusion: Changes planned by the Office of VAMOSC to provide separation of modification costs from PDM costs will materially enhance the visibility of these expenses.

Recommendation: The Office of VAMOSC should continue its efforts to develop the means for providing separate visibility of PDM and modification costs.

Office of VAMOSC Comments: "Concur. A Data Automation Requirement is being prepared. Expected implementation date is FY86."

2. Allocation of Depot Maintenance Costs (See page 15)

Conclusion: The method proposed by the Office of VAMOSC to base the allocation of depot maintenance costs on completions ratios will result in allocations which are more valid than the present allocations based on flying operations ratios.

Recommendation: The Office of VAMOSC should continue its development of a completions ratio basis for allocation of depot maintenance costs.

Office of VAMOSC Comments: "Concur in part. It is expected that this will become a phase II validation/verification tasking. Implementation will follow within 12 months of methodology delivery. The OOV currently expects that this methodology will include NRTS actions as well."

3. General Depot Support Cost Identification (See pages 18-20)

Conclusion: The Office of VAMOSC has postulated that costs within the three depot directorates associated with the supply pipeline are driven by different factors. Based on its review, Desmatics concurs with the Office of VAMOSC in this concept.

Recommendation: The Office of VAMOSC should continue its efforts to develop a separate allocation factor for each directorate to be used in identifying the aircraft portion of directorate costs.

Office of VAMOSC Comments: "Concur. Expected implementation is for FY86 processing."

4. Allocation of General Depot Support Costs to the MDS Level (See page 20)

Conclusion: Allocation of these costs to the MDS level using flying operations ratios is not optimum. Desmatics concurs with the Office of VAMOSC's concept of using completions and/or NRTS actions data as an allocation basis.

Recommendation: The Office of VAMOSC should continue its development of data sources for completions and NRTS actions data, and should replace allocations based on flying operations data with algorithms based on completions and/or NRTS data.

Office of VAMOSC Comments: "Concur. As soon as D160B data stabilizes and the preprocessor is established as a system common to all VAMOSC subsystems, this data will be requested by WSSC from D160B. Expected MOA initiation date is FY84 with FY85 implementation date."

5. Depot Installation Support Fixed Costs (See pages 27-28)

Conclusion: A portion of depot installation support cost is a fixed cost independent of the workload. This fixed component should be identified if possible and excluded from the aircraft burden. Desmatics is assessing the feasibility of using regression techniques to identify the fixed cost component and will report its findings at a later date.

Recommendation: The Office of VAMOSC should treat a portion of depot installation support cost as fixed and exclude it from WSSC, using regression techniques if Desmatics is able to establish their feasibility. Failing this, it would provide a more accurate portrayal of these costs to exclude a reasonable percentage as fixed than to treat all costs as variable as is presently the case.

Office of VAMOSC Comments: "Concur. Pending results of regression analysis in Volume VII of this report, further action will be delayed. If implemented, the OOV position on recommendation 7 below will be reviewed."

6. Directorate Installation Support Costs (See pages 29-31)

Conclusion: Currently only the installation support costs of the Directorate of Maintenance are included in depot installation support.

A share of the costs in support of the other three directorates should be included.

Recommendation: The Office of VAMOSC should revise the algorithm for allocating shares of depot installation support costs so that support costs for the Directorates of Procurement, Materiel Management, and Distribution are also included.

Office of VAMOSC Comments: "Concur. This algorithm will be changed for FY86 processing."

7. Excluding Installation Support Personnel (See page 29)

Conclusion: The current algorithm for allocating depot installation support cost uses base population in the denominator, thus inherently allocating a portion of the cost to the supporting personnel themselves, contrary to common cost accounting practice.

Recommendation: The Office of VAMOSC should revise depot installation support cost factors so that installation support personnel are subtracted from the base population before they are used in the denominators of the depot factors.

Office of VAMOSC Comments: "Do not concur. It is appropriate to allocate support personnel costs to support personnel as these represent a fixed element of depot costs properly excluded from WSSC reporting. See recommendation 5 above."

8. Allocating Installation Support Costs to Aircraft (See pages 29-30)

Conclusion: The methodology proposed by the Office of VAMOSC to use completions and/or NRTS actions data for allocating depot installation support costs to the CMD/GELOC/MDS level will result in a more equitable allocation basis than the current use of flying operations ratios.

Recommendation: The Office of VAMOSC should continue its efforts to develop ratios based on completions and/or NRTS action data.

Office of VAMOSC Comments: "Concur. As soon as D160B data stabilizes and the preprocessor is established as a system common to all VAMOSC subsystems, this data will be requested by WSSC from D160B. Expected MOA initiation date is FY84 with FY85 as projected implementation date."

9. Depot Factor Computation (See page 31)

Conclusion: In general, Desmatics concurs with the concept of using depot factors to identify the share of installation support costs at depots to be assessed against aircraft. This concept employs a strength ratio to identify the supported strength and a direct labor manhour ratio to identify that portion related to aircraft. However, the current algorithm computes a separate strength ratio for each depot, but uses a single, overall manhour ratio. A separate manhour ratio for each depot would provide a more precise allocation. If depot installation support is to be included for the other three directorates (in line with recommendation No. 6), the ratios proposed for General Depot Support could be used to identify the aircraft share.

Recommendation: The Office of VAMOSC should develop a separate depot maintenance manhour ratio for each depot. (If recommendation No. 6 is implemented, an analogous ratio would also have to be developed for the allocation basis used in each of the other three directorates.)

Office of VAMOSC Comments: "Concur. The depot maintenance manhours ratio for each depot will be calculated and used in deriving a separate depot factor for each ALC during FY83 processing. Upon implementation of Recommendation 6, appropriate ratio(s) will be developed and presented to the current validation/verification contractor for review and conclusion."

10. Identification of Sustaining Investment Costs (See pages 34-35)

Conclusion: The FY82 switch to the use of H036C condemnation data as a source for replenishment spares costs materially enhances the visibility of these costs. The plan of the Office of VAMOSC to obtain modification completions data from G079 and G072E sources should greatly improve the visibility of modification costs.

Recommendation: The Office of VAMOSC should continue to pursue the development of modification cost algorithms based on completions data.

Office of VAMOSC Comments: "Concur. A Data Automation Requirement is being prepared and projected completion date is FY86."

11. Unreplenished Condemnations (See page 35)

Conclusion: Not every condemnation represents an expenditure for replenishment of spares. Examples are parts condemned because they are no longer used.

Recommendation: The Office of VAMOSC should exclude all condemnations which do not result in a replenishment expenditure.

Office of VAMOSC Comments: "Do not concur. Condemnations that occur due to operational failures should be included regardless of replenishment action. Condemnation of serviceable assets to reduce inventory may or may not be appropriately included. The OOV will review this issue for possible action."

12. Ground Support Equipment (See pages 36-38)

Conclusion: CAIG defines sustaining investment as also including the cost of replacing support equipment. WSSC currently provides no cost visibility in this area, primarily because of the difficulty of allocating common support equipment costs among MDSs. A similar problem occurs with respect to the cost of maintenance of GSE items, which WSSC currently allocates based on the maintenance manhours expended on the aircraft themselves. In the absence of a more direct allocation basis, a reasonable alternative is to allocate worldwide GSE replacement costs among MDSs in proportion to the total of all base and depot maintenance direct labor cost expended against the aircraft.

Recommendation: The Office of VAMOSC should consider allocating costs for replacement of common aircraft GSE items in proportion to the combined base and depot direct labor cost expended against the aircraft.

Office of VAMOSC Comments: "Concur in part. Allocation is an appropriate methodology. However, the basis of this allocation should give weight to the location of common SE. The proposed methodology will be presented to the V & V contractor during FY84 for further review."

13. TCTO Kit Base Material Costs (See page 36)

Conclusion: WSSC currently treats the costs of those TCTO Kits

composed of components drawn from base supply as a below depot maintenance materiel expense, whereas the D160B System treats them as sustaining investment. Desmatics favors the latter approach.

Recommendation: The Office of VAMOSC should determine the materiel costs for base-assembled TCTO Kits using data from the D002A system via D160B, add these costs to sustaining investment and subtract them from below depot maintenance.

Office of VAMOSC Comments: "Concur. D160B can provide kit materiel costs to WSSC. After completion of the common preprocessor, the appropriate MOA will be initiated (FY84). Based upon completion of reprogramming of CSCS (D160B) the data will be used in the following FY processing by WSSC."

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